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# EFFECT OF STORAGE AND REPEATED SPROUTING OF SEED POTATOES ON THEIR GROWTH AND PRODUCTIVENESS

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## CONTENTS

| | Page |
|---|---|
| Introduction | 1 |
| Review of literature | 1 |
| Materials and methods | 2 |
| Sprout development and loss in weight of different stored lots | 3 |
| Rate of development and yield from differently stored seed | 5 |
| Discussion | 8 |

## INTRODUCTION

There is a somewhat prevalent belief among seedsmen and growers that potatoes sprouted to any considerable degree are less desirable than unsprouted ones for seed purposes. As a rule such sprouted seed is found in storage houses or house cellars where the temperature and ventilation have not been properly controlled. Under such conditions there is no way of judging to what extent the vitality of the seed has been reduced by sprouting. It is conceivable that a certain amount of sprouting can occur without an appreciable reduction in vigor or productiveness, but heretofore no extensive study has been made to determine to what extent excessive or even moderate sprouting may reduce the yield.

As used in this discussion the term "sprouting" includes all growth activity of the unplanted tuber that occurs in the unlighted storage house or cellar, as well as that purposely induced in the light and commonly referred to as "budding" or "greening."

## REVIEW OF LITERATURE

Emerson[1] compared plantings from badly sprouted and shrunken tubers that had been stored in a cellar with those from practically unsprouted seed that had been stored in an outdoor pit. The yield from 100 pounds of the sprouted tubers totaled 566 pounds, whereas an equal amount of unsprouted seed gave 870 pounds, an increase of about 54 percent for the latter.

Using the McCormick and Irish Cobbler varieties, Appleman[2] studied the effect of repeated sprout removal on the vigor of the sprouts, and the effect of repeated sprouting on yield. He measured the diminution in vigor of successive lots of sprouts by dividing the average weight of sprouts by their average length. Nine sets of sprouts were removed and a marked reduction in vigor was noted in the later sets. The removal of four sets of sprouts that developed in damp sawdust did not cause any decrease in tuber yield. He found that home-grown Irish Cobbler seed potatoes held in cold storage from September 24 to March 1, and then placed in damp sawdust at a higher temperature until planted in the field on July 5, during which time nine sets of sprouts were removed, produced only half as large a yield per plant as a similar lot held in cold storage until June 30 and then allowed to warm up until planted July 5. From these facts Appleman concluded that at least four sets of sprouts, 2 to 3 inches long, may be removed from McCormick tubers without materially affecting the yield and that repeated sprouting of the Irish Cobbler appeared to weaken it sooner than the McCormick.

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[1] EMERSON, R. A. POTATO EXPERIMENTS. Nebr. Agr. Expt. Sta. Bull. 97, 26 pp. 1907. See section Sprouted vs. unsprouted tubers.

[2] APPLEMAN, C. O. POTATO SPROUTS AS AN INDEX OF SEED VALUE. Md. Agr. Expt. Sta. Bull. 265, pp. 237-258, illus. 1924.

## MATERIALS AND METHODS

The primary purpose of this study of repeated sprouting of seed potatoes was to obtain data on the effect of different sprouting treatments on potato growth and yields. This investigation was begun in Maine in 1927 and completed in 1930.

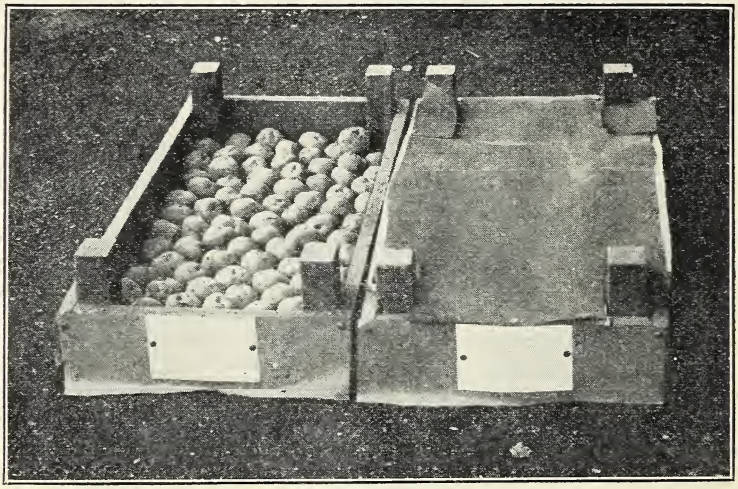

FIGURE 1.—Uncovered (lot C) and covered (lot B) lots of Irish Cobbler tubers showing arrangement in flats and method of excluding light from lot B. Both kept in indirect light under the greenhouse bench.

Each year from 1927 to 1930, inclusive, 300 tubers each of the Irish Cobbler and Green Mountain varieties of approximately 3 ounces in weight were divided into three lots of 100 each. The tubers of each lot were then placed on their stem ends in shallow trays or flats. Early in April one lot of each variety was placed in the potato house in the dark where they were subjected to a relative humidity of approximately 86 percent and a temperature ranging from 36° F. at the outset to 50° by May 10. The remaining two lots of each variety were placed under the greenhouse bench out of direct sunlight, one lot of each being covered with black building paper to exclude the light, and the other left uncovered and therefore exposed to indirect light. Each lot of material was weighed at the beginning of the experiment and at irregular intervals thereafter until planted.

When a large percentage of the sprouts of those lots from which light was excluded had attained a length of 2 inches, all lots were weighed and the sprouts removed.

The duration of the sprouting period varied somewhat from year to year. In 1927 it extended from April 8 to June 13, 66 days; in 1928, from April 6 to June 11, 66 days; in 1929, from April 5 to May 20, 45 days; and in 1930, from February 17 to May 20, 92 days.

In order to facilitate discussion of these six lots they are referred to by letters as follows: A, Irish Cobbler in the potato storage house; B, Irish Cobbler in the dark under the greenhouse bench (fig. 1); C, Irish Cobbler in indirect light under the greenhouse bench; D, Green Mountain in the potato storage house; E, Green Mountain in the dark under the greenhouse bench; F, Green Mountain in indirect light under the greenhouse bench, as shown for lots B and C in figure 1.

The dates of sprout removal from lots B and E were May 18 and June 3, 1927; May 4, May 22, and June 6, 1928; April 14, May 7, and May 22, 1930. One set of sprouts was removed from lots C, D, and F in 1927, and from D in 1928. The data for loss in weight are given in table 1.

TABLE 1.—*Loss in weight in sprouting Irish Cobbler and Green Mountain tubers under different storage conditions, 1927, 1928, and 1930*

| Lot and treatment | 1927 [1] | | 1928 [1] | | 1930 [2] | | 3-year average |
|---|---|---|---|---|---|---|---|
| | Times sprouts removed | Loss in weight | Times sprouts removed | Loss in weight | Times sprouts removed | Loss in weight | Loss in weight |
| | *Number* | *Percent* | *Number* | *Percent* | *Number* | *Percent* | *Percent* |
| A, Irish Cobbler in dark in potato house | 0 | 6.4 | 0 | 7.5 | 0 | 6.4 | 6.8 |
| B, Irish Cobbler in dark under greenhouse bench | 2 | 18.1 | 3 | 18.5 | 3 | 20.7 | 19.1 |
| C, Irish Cobbler in indirect light under greenhouse bench | 1 | 15.3 | 0 | 11.4 | 0 | 18.4 | 15.0 |
| D, Green Mountain in dark in potato house | 1 | 10.3 | 1 | 4.9 | 0 | 6.4 | 7.2 |
| E, Green Mountain in dark under greenhouse bench | 2 | 23.1 | 3 | 16.4 | 3 | 19 | 19.5 |
| F, Green Mountain in indirect light under greenhouse bench | 1 | 25.8 | 0 | 12.6 | 0 | 16.4 | 18.3 |

[1] 66-day period.

[2] 92-day period.

## SPROUT DEVELOPMENT AND LOSS IN WEIGHT OF DIFFERENT STORED LOTS

The average loss in weight during the sprouting period for Irish Cobbler was 27.3 percent greater for lot B than for lot C. There was also a much larger weight loss for both varieties when stored in the greenhouse than when stored in the potato house. This was to be expected because of the higher temperature and the lower humidity of the greenhouse. A close relation is noted in the 3-year average data of lots A and D, which were held in the storage house. The greater percentage of loss from lots B and E, when compared with C and F, is perhaps attributable chiefly to sprout removal. One set of sprouts removed from C and F accounts partly for the heavy loss in these two lots in 1927 and partly to the high temperature and low humidity in the greenhouse. In 1928 several tubers of lots B and E which had been covered 66 days lost apical dominance (fig. 5). The relatively high weight loss of lots B and E in 1930 when compared with the preceding year is attributed to the longer sprouting period.

The sprout characters of the tubers held under the three sets of conditions previously described are well illustrated in figures 2, 3, 4, 5, and 6. Figures 2 and 3 show the difference between sprouts developed in the dark and those developed in the light. The lower temperature at which lot A was held retarded sprouting, therefore comparison of lots A and B should be confined to thickness of sprouts. Figure 4 indicates the general appearance of the sprouts of Green Mountain tubers held for 66 days in the storage house in the dark. Irish Cobbler tubers stored in the same place showed a similar sprout development. Figure 5 illustrates the general appearance of tubers held in the dark in the greenhouse for 66 days from which three sets of sprouts have

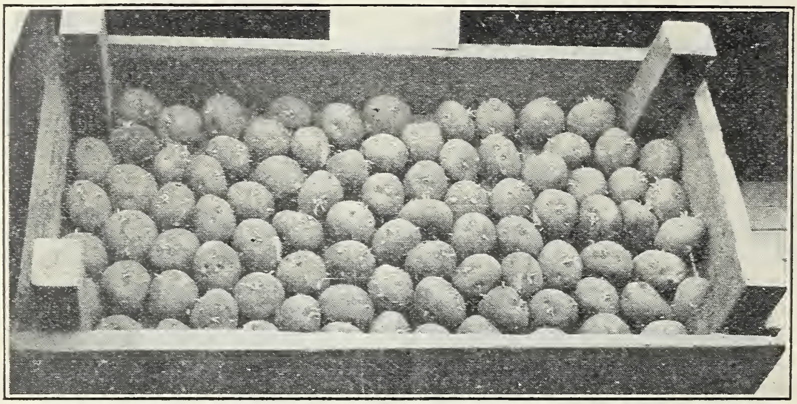

FIGURE 2.—Lot A. Sprout development of Irish Cobbler tubers after 40 days in the potato storage house in the dark at 36° to 50° F., 1927.

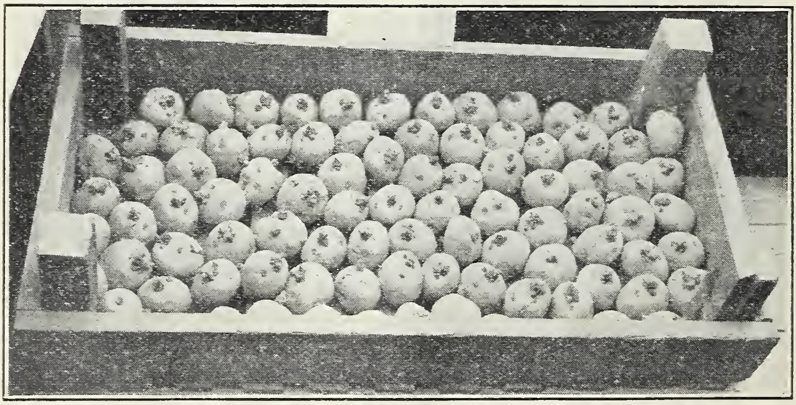

FIGURE 3.—Lot C. Sprout development of Irish Cobbler tubers after 40 days in indirect light under greenhouse bench at greenhouse temperature, 1927. Note thickness of sprouts.

developed, and is to be compared with figure 6, showing tubers which have developed one set of sprouts in indirect light in the same length of time. The sprout development shown in figure 3 may be regarded as the extreme limit for successful handling in a machine planter; that shown in figure 6 is too long for commercial practice.

## RATE OF DEVELOPMENT AND YIELD FROM DIFFERENTLY STORED SEED

The date of planting varied with the year. In 1927 test plots were planted June 13; in 1928, June 11; in 1929, May 29; and in 1930, May 22. The 3-ounce tubers were halved longitudinally and planted immediately by hand in rows 3 feet apart with sets spaced 14 inches in the row. Four 50-hill plots of each lot were replicated systematically in the field.

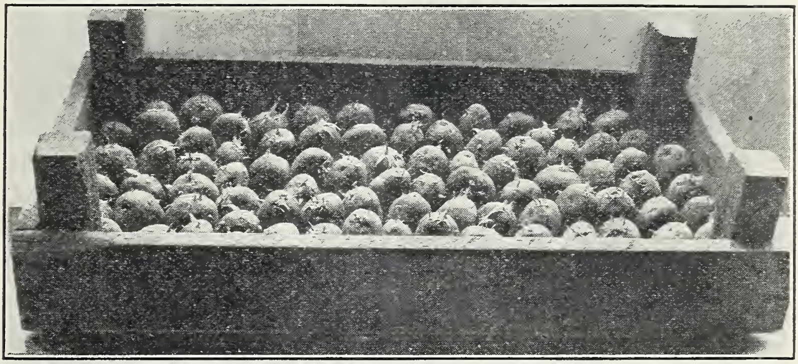

FIGURE 4.—Lot D. Sprout development of Green Mountain tubers after 66 days in the potato storage house in the dark at 36° to 50° F., 1928.

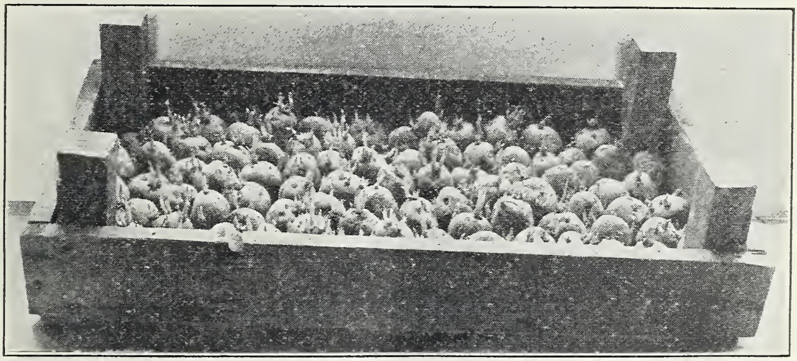

FIGURE 5.—Lot B. Stage of development of third set of sprouts from Irish Cobbler tubers after 66 days under greenhouse bench in the dark, 1928.

Some variation was noted in date of appearance of the plants from the different lots of seed; C and F were the first, A and D second, and B and E last to emerge from the soil. Time of flowering also varied considerably in the different lots, the recorded date being when approximately 50 percent of the plants in each lot were in full bloom. For Irish Cobbler, flowering of lot A was 4 days earlier than lot C and 10 days earlier than lot B; for Green Mountain, lot D was 6 days earlier than lot F and 12 days earlier than lot E. Although no measurements were made of the height of plants there were no appreciable differences at any time between the plants of lots A and C, or of D and F. But those of lots B and E were considerably smaller than those of the adjoining rows of the same variety up to the time the blossoms had fallen and the foliage had filled the rows, after which no further differences were observed.

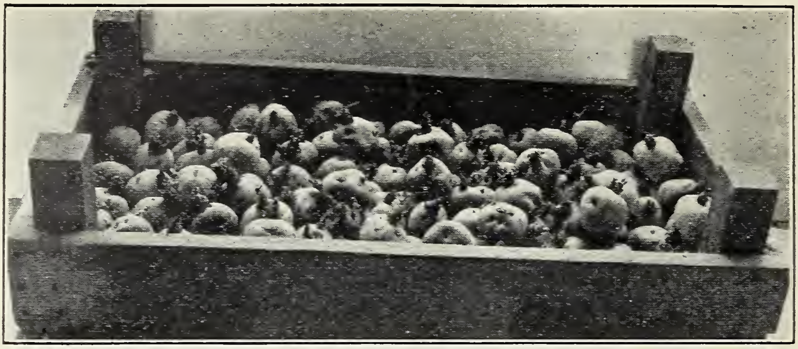

FIGURE 6.—Lot C. Sprout development of Irish Cobbler tubers after 66 days' exposure to indirect light, 1928.

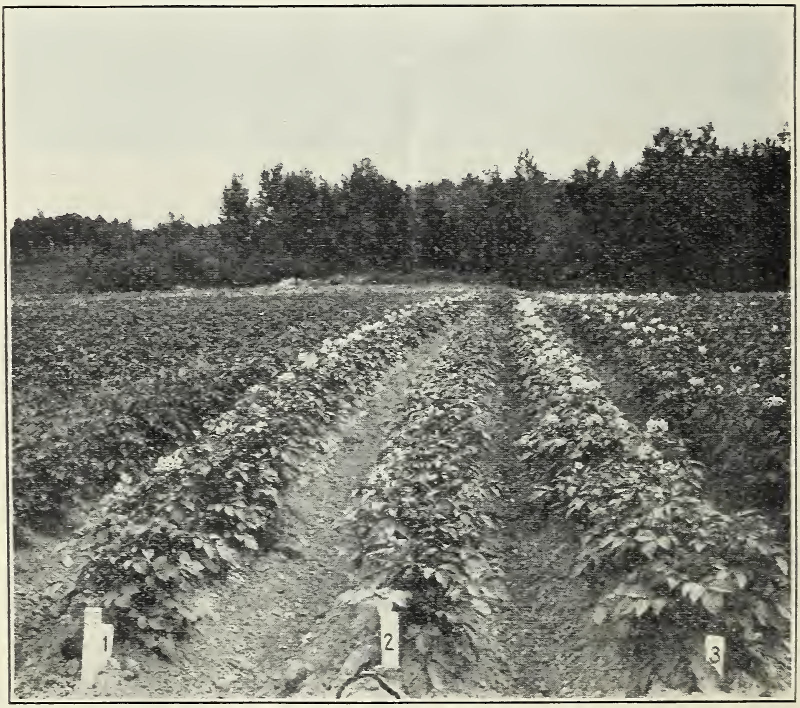

FIGURE 7.—Appearance of plants and amount of blossoming of three lots of Irish Cobbler on July 23, 1927, grown from seed treated as follows: Row 1, lot A, potato storage-house seed held at 36° to 50° F. in the dark until planted; row 2, lot B, seed kept covered in greenhouse for 66 days before planting; row 3, lot C, seed light-exposed in the greenhouse for 66 days before planting. All lots planted June 3.

Differences in amount of bloom and size of plants of the 1927 crop 50 days after planting are shown in figure 7.

The average yields per acre of Irish Cobbler and of Green Mountain over a period of 4 years, 1927–30, for the three treatments are given in table 2.

TABLE 2.—*Average yield per acre of Irish Cobbler and of Green Mountain potatoes following different sprouting treatments in 4 years*

| Year | Irish Cobbler |  |  |  | Green Mountain |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  | Lot and treatment | Times sprouts removed | Primes | Total | Lot and treatment | Times sprouts removed | Primes | Total |
|  |  | *Number* | *Bushels* | *Bushels* |  | *Number* | *Bushels* | *Bushels* |
| 1927 | A, in dark in potato storage house. | 0 | 419.0 | 430.9 | D, in dark in potato storage house. | 1 | 423.7 | 439.2 |
| 1928 |  | 0 | 315.8 | 342.0 |  | 1 | 296.8 | 355.4 |
| 1929 |  | 0 | 231.8 | 291.4 |  | 0 | 290.4 | 324.6 |
| 1930 |  | 0 | 287.3 | 377.5 |  | 0 | 338.1 | 384.3 |
| Average |  |  | 313.4 | 360.5 |  |  | 337.2 | 375.9 |
| 1927 | B, in dark under greenhouse bench. | 2 | 368.7 | 392.5 | E, in dark under greenhouse bench. | 2 | 361.4 | 392.6 |
| 1928 |  | 3 | 218.6 | 285.7 |  | 3 | 152.5 | 277.6 |
| 1929 |  | 3 | 226.6 | 280.5 |  | 3 | 242.7 | 314.2 |
| 1930 |  | 3 | 307.5 | 417.4 |  | 3 | 282.2 | 357.4 |
| Average |  |  | 280.4 | 344.1 |  |  | 259.7 | 335.4 |
| 1927 | C, in indirect light under greenhouse bench. | 1 | 374.9 | 405.0 | F, in indirect light under greenhouse bench. | 1 | 359.4 | 382.8 |
| 1928 |  | 0 | 309.6 | 335.2 |  | 0 | 350.2 | 370.3 |
| 1929 |  | 0 | 226.1 | 283.1 |  | 0 | 307.5 | 332.9 |
| 1930 |  | 0 | 275.9 | 404.4 |  | 0 | 272.2 | 311.6 |
| Average |  |  | 296.6 | 356.9 |  |  | 322.3 | 349.4 |

A wide variation was found in the seasonal results, and significant differences between treatments occurred each year with the exception of 1929.

In most cases the increased yield of either variety for both primes or total yield was in favor of the potato-house treatment, and, since any increase in yield for this treatment can be attributed to the effect of storage temperature and humidity, these comparisons are not cited. Significant yield[3] differences were found between the two greenhouse lots for both varieties in 1928 for both primes and total yield. With Irish Cobblers, lot C gave an increased yield over lot B with odds of 130 to 1 for primes and 27 to 1 for total yield; with Green Mountains, lot F gave an increased yield over lot E with odds of 1,000 to 1 for primes and 40 to 1 for total yield. The yield differences between the two greenhouse lots this year were probably due to the unfavorable climatic conditions. The number of bushels per acre necessary to give significant differences between treatments for the 4-year period was as follows: Between lots B and C of Irish Cobbler differences of at least 55.4 bushels of primes and 53.8 total yield were necessary to be significant, and between lots E and F of Green Mountain, differences of 75.3 bushels of primes and 82.7 total yield were necessary.

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[3] Calculated by the "Student" method of comparing 2 results on a probable error basis.

## DISCUSSION

For four consecutive seasons in testing the relative weakening effect of excessive sprouting of Irish Cobbler and Green Mountain potatoes, one lot of each variety was held in the potato house for 66 days with a relatively high humidity and a storage temperature not exceeding 34° F. during the winter months and varying from 36° to 50° through April and May. These potatoes sprouted very little and the average loss in weight for 3 seasons (over a 3-year period) was 6.8 percent for Irish Cobblers, lot A, and 7.2 percent for Green Mountains, lot D. A second lot of each variety was held in the greenhouse for the same length of time in the dark with a high temperature and a low humidity. Two sets of 2-inch sprouts were removed from this material in 1927 and three sets in 1928 and 1930. The average loss in weight, including weight of removed sprouts, was 19.1 percent for Irish Cobbler, B,[4] and 19.5 percent for Green Mountain, E. A third lot of each variety was held in the greenhouse for the same period of time in subdued light with the same temperature and humidity as the preceding. The tubers of these lots were allowed to green and the sprouts to develop. Loss in weight of Irish Cobbler, lot C, was 15 percent and for Green Mountain, lot F, 18.3 percent.

Field observations indicated delayed emergence and blooming of the plants produced by lots B and E. This was expected because not only was the temperature high and the humidity low but in addition, two or three sets of sprouts were removed each year, the last set coming off the day before the tubers were planted. Also a large percentage of the tubers had lost apical dominance and only lateral sprouts were developing. In the case of lots A and D and C and F, strong sprouts were already present when the tubers were planted, and in the case of the latter two lots the sprouts were of considerable length.

Some significant yield differences were found in favor of the storage-house material in 1927 and 1928, which can be attributed to the effect of storage conditions on the seed.

In only 1 year (1928) was there any significant difference between the yields of the two greenhouse lots. Lot C gave a significant increase in yield over B, and F a significant increase over E. Over the 4-year period, however, there was no significant difference.

Under the conditions of this experiment, sprout removal to the extent of three sets of 2-inch sprouts did not significantly reduce the yield of these two varieties.

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[4] B, C, E, and F held in greenhouse for 92 days in 1930.

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